CBMS Studio BACnet Router User's Manual

No.23/453 Soi Westerm Railway
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Introduction

The CBMS Studio gateway provides routing between BACnet/IP, BACnet/MSTP and Modbus networks. It is fully programmable with a graphical programming language supporting HVAC functions, time scheduling, alarms and histories. It can be used as a standalone router between BACnet/IP and BACnet/MSTP, or it can provide advanced control of BACnet or Modbus devices connected to the network.

There are 3 physical communication ports, 1 Ethernet and 2 RS485 ports on the CBMS gateway. It has drivers for BACnet/IP, BACnet/MSTP, Modbus/RTU and Modbus/TCP. It is powered from a 24 VAC power source and can be mounted on a 35 mm Din rail.

The default application running on the gateway has 1 BACnet/IP port configured as well as 2 BACnet MSTP ports. This document describes the configuration required for operation as a BACnet/IP to BACnet/MSTP router.

CBMS Studio has been built using the open source Sedona Framework™.

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In a BACnet system, devices can be connected to different physical network such as Ethernet and RS485. In order to communicate across these physical networks, a BACnet router is required and each physical network is given a unique network number in the range 1 to 65535. In addition to the network numbers, each device on the network must be given a unique device ID in the range 0 to 4194303 regardless of the physical network that it is located in. These 3 settings are the bare minimum settings that require to be changed.

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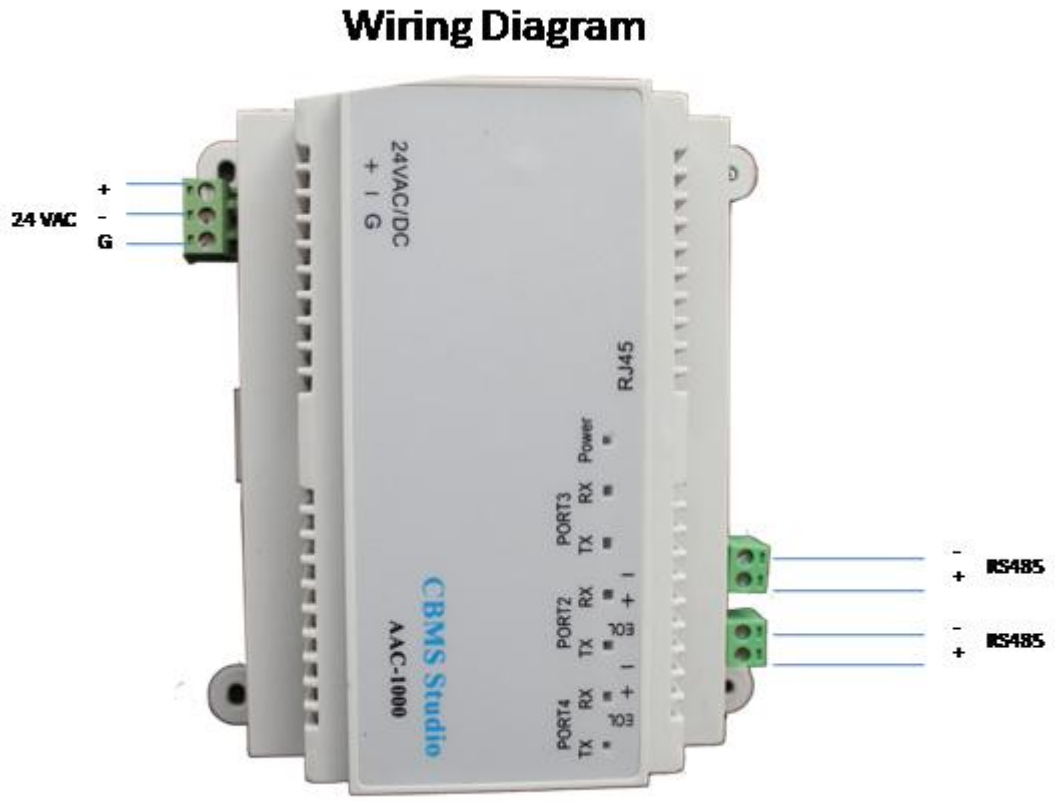
Configuration

Getting Started

The configuration of the router can be done with a Web Browser, CBMS Studio Engineering Tool or the Niagra Workstation. This manual will describe the configuration using a web browser and the CBMS Studio Engineering Tool.

Connect 24 VAC power to the AAC-1000 using a standard 24 VAC power supply as shown by the diagram below.

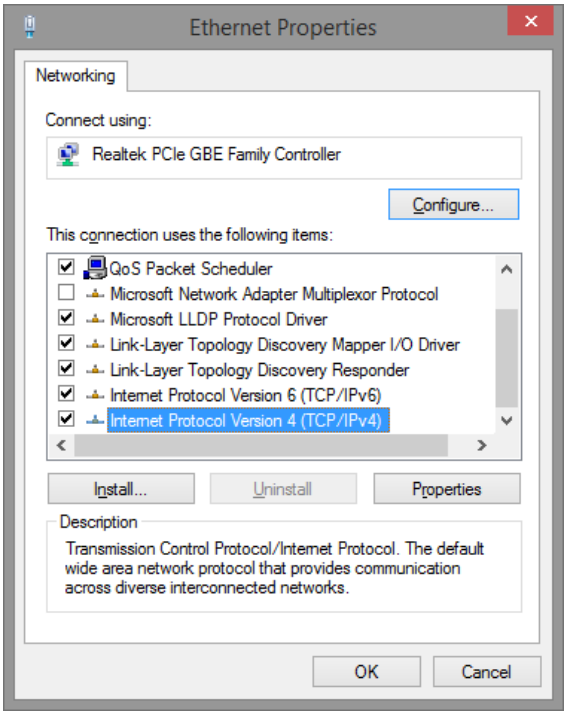


Ethernet Connection

When the device is shipped it is configured with a static Ethernet address of 192.168.1.100. If your PC is already connected to the Sub domain 192.168.1.x then you can connect the AAC-1000 directly to this network and skip the following instructions for connecting an Ethernet cable directly to the AAC-1000.

If you are using a different subnet then you can connect an Ethernet cable from your PC directly to the Ethernet port of the AAC-1000. Once you have connected the 24 VAC power and Ethernet cable, go to your PC settings and change your IP address to a static address of 192.168.1.1.

- For Windows 8, right click on Windows Icon at the lower left of your screen and select “Network Connections”
- From the Network Connections dialog, find your Ethernet adapter right click and then select “Properties”
- This will display the “Ethernet Properties” dialog box as shown below.



- Select Internet Protocol Version 4 and then select “Properties” to display the following dialog box.

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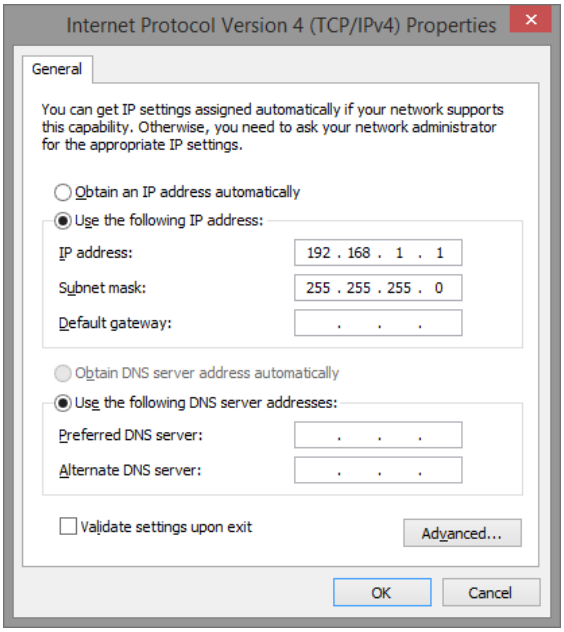
Internet Protocol Version 4 (TCP/IPv4) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 1 . 1
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

- Change the IP address to use a static IP address of 192.168.1.1

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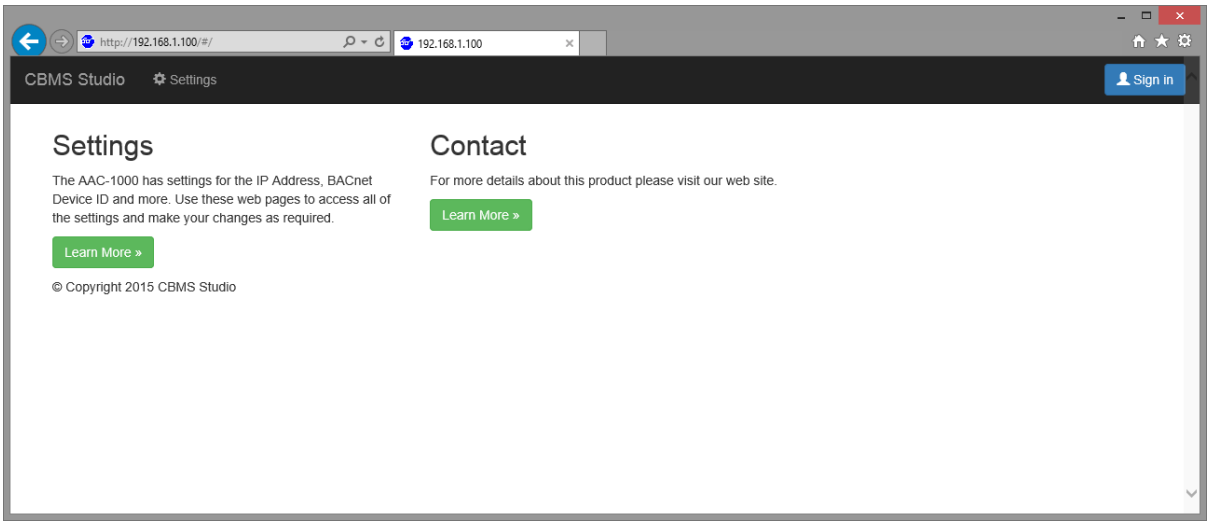
Web Browser

Using the web browser on your PC, open up the AAC-1000 web configuration screen with the IP address of 192.168.1.100


http://192.168.1.100/#/
192.168.1.100
CBMS Studio
Settings
Sign in
Settings
The AAC-1000 has settings for the IP Address, BACnet Device ID and more. Use these web pages to access all of the settings and make your changes as required.
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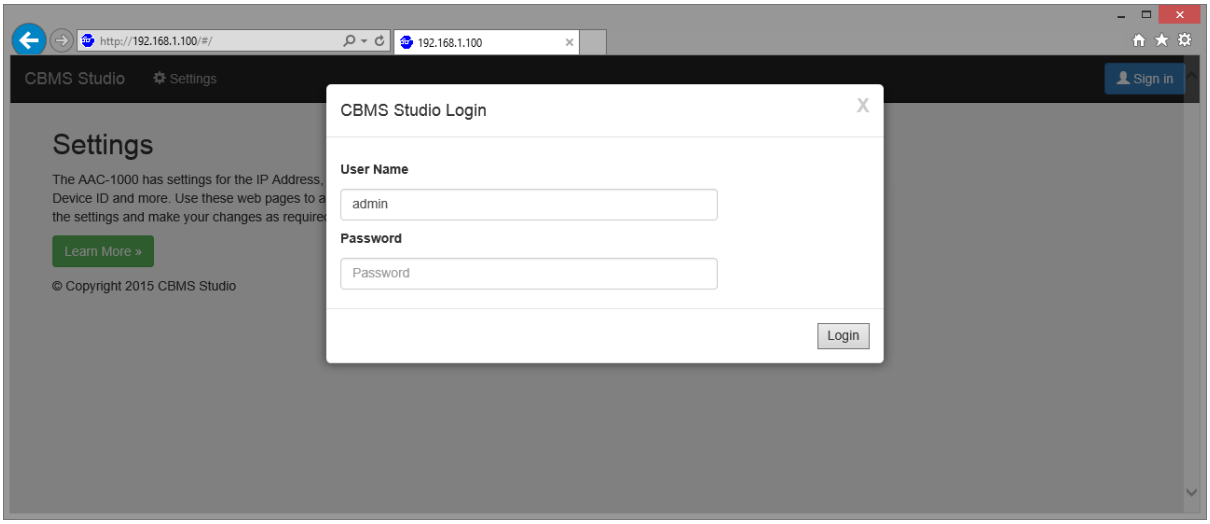
Contact
For more details about this product please visit our web site.
Learn More »

Click the “Settings” menu tab to bring up the login dialog and enter your username and password. The default username is admin, the password is empty.



If the login is successful you will be taken to the general settings page of the AAC-1000 where you can change the basic settings of the BACnet IP to MSTP router.

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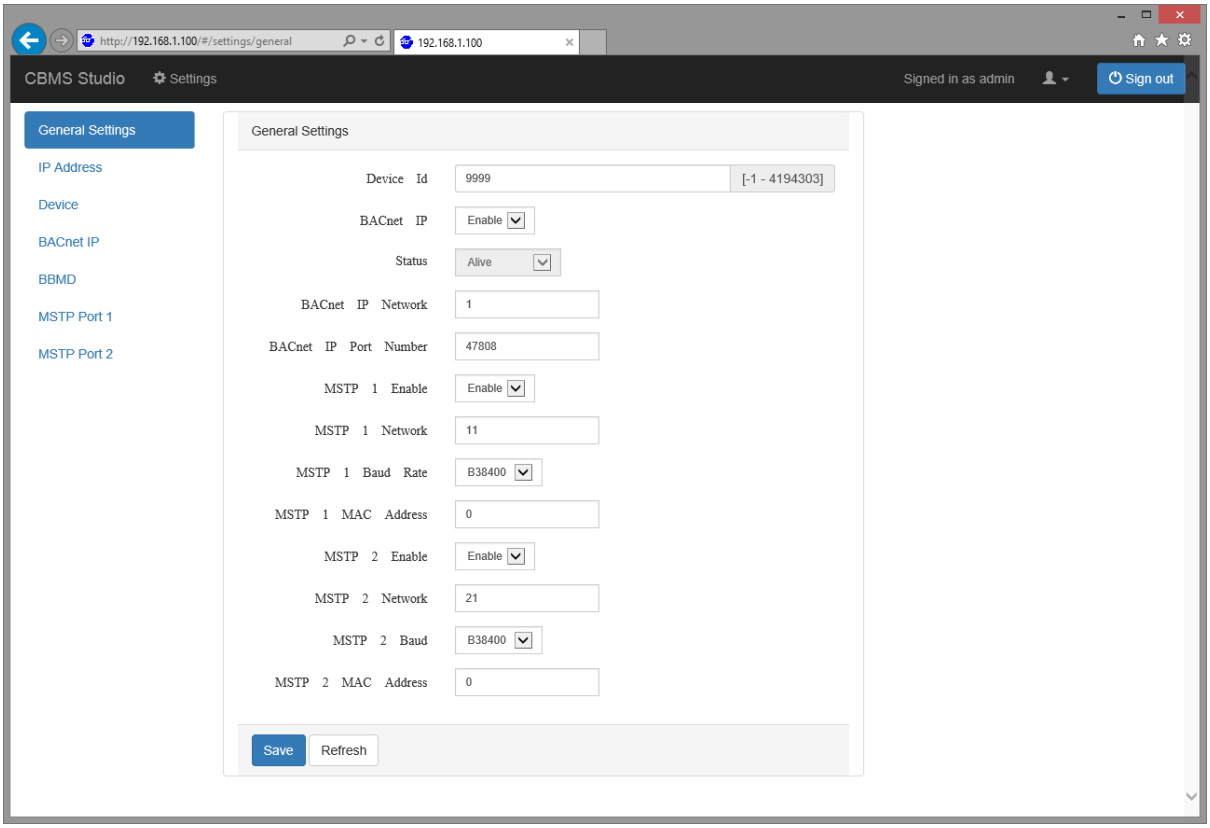
General Settings

The basic settings of the BACnet IP to MSTP router can be changed from this page. For most systems, these are the only settings that will need to change.



The following settings can be changed from the general settings page. The save button must be selected after changing any of the values in order to save the settings to the device.

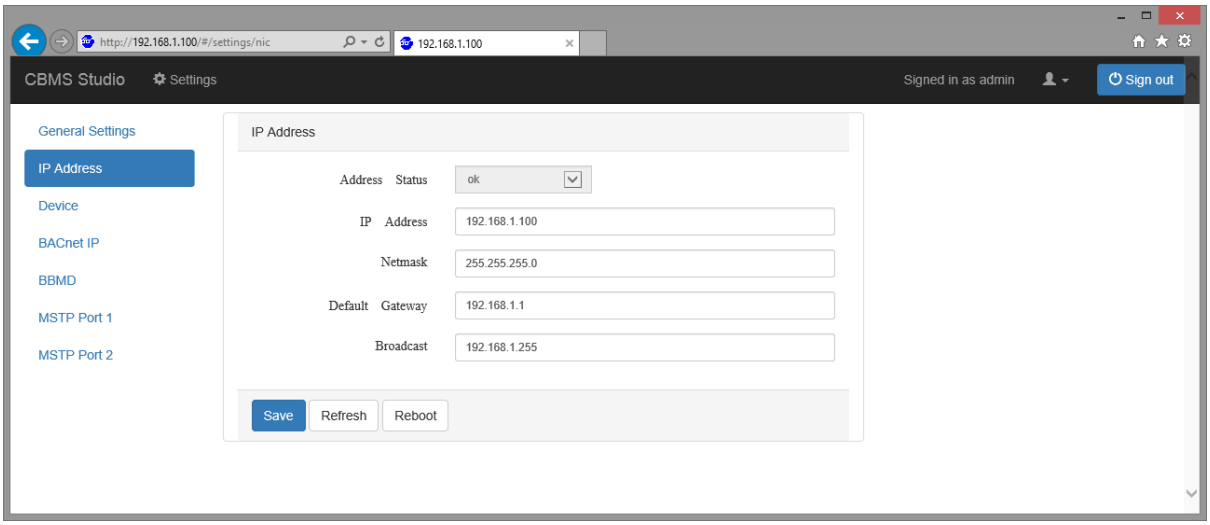
- Device ID. This is the BACnet device ID corresponding to the AAC-1000, it must be changed to a unique number on the BACnet network. The default value is 9999.
- BACnet IP Enable. This should be left as enabled and it should only be deactivated if the BACnet IP to MSTP routing is not required.
- BACnet IP network number (1-65535). This value represents the BACnet IP network number for all devices connected to the IP network. All devices on the IP network should use the same network number. This setting defaults to 1 and can be left unchanged on most systems.
- BACnet IP Port number. The default setting is 47808 (0xBAC0) and can be left unchanged on most systems.

The following settings are common to both MSTP networks.

- MSTP Enable. When the port is enabled, the AAC-1000 will act as a BACnet IP to MSTP router on this port. If the MSTP port is not used then the port should be disabled.
- MSTP network number (1-65535). This value represents the BACnet MSTP network number for all devices connected to this MSTP port. This setting defaults to 11 and each MSTP port requires a unique network number. If there are multiple AAC-1000 devices used, then the network number on each MSTP port will need to be changed with a unique number.
- MSTP Baud Rate. The AAC-1000 baud rate does not auto select and the value used should correspond to the value required by the MSTP devices.
- MSTP MAC address. Each MSTP device requires a unique MAC address in the range 0-127. It is common for the MSTP router to have a MAC address of zero, so this value can be left unchanged for most systems.

IP Address

The IP Address settings can be changed on this page.



The following settings are available on this page.

- IP Address. This is the static IP address used by the AAC-1000
- Netmask. The netmask is used by the AAC-1000 when broadcasting messages on the network. For a class A network, this will be set to 255.255.255.0. If in doubt please consult your network administrator .
- Default Gateway. This setting is used by the AAC-1000 when it needs to connect to the internet. In most systems am internet connection is not required and this setting is not used.
- Broadcast Address. This setting is read only and is derived from the IP address and netmask.

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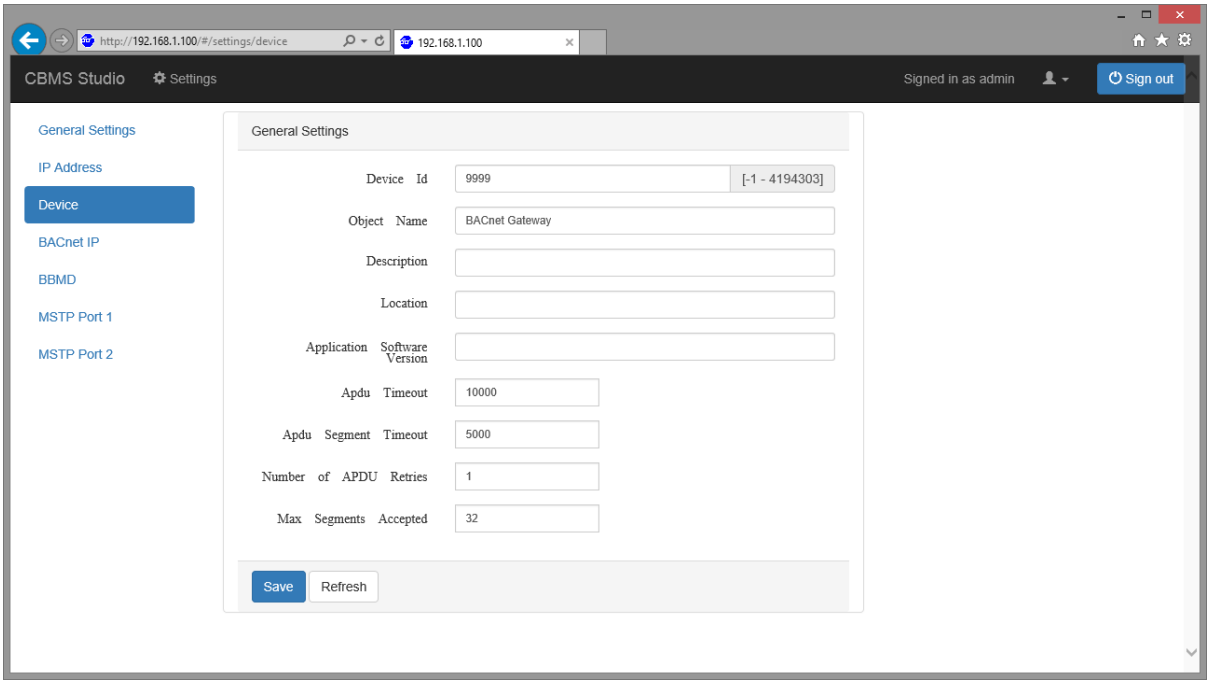
Device

From this page, the BACnet device settings for the AAC-1000 can be configured. These are the values that are displayed on the BACnet device object and will be readable from a BACnet client.



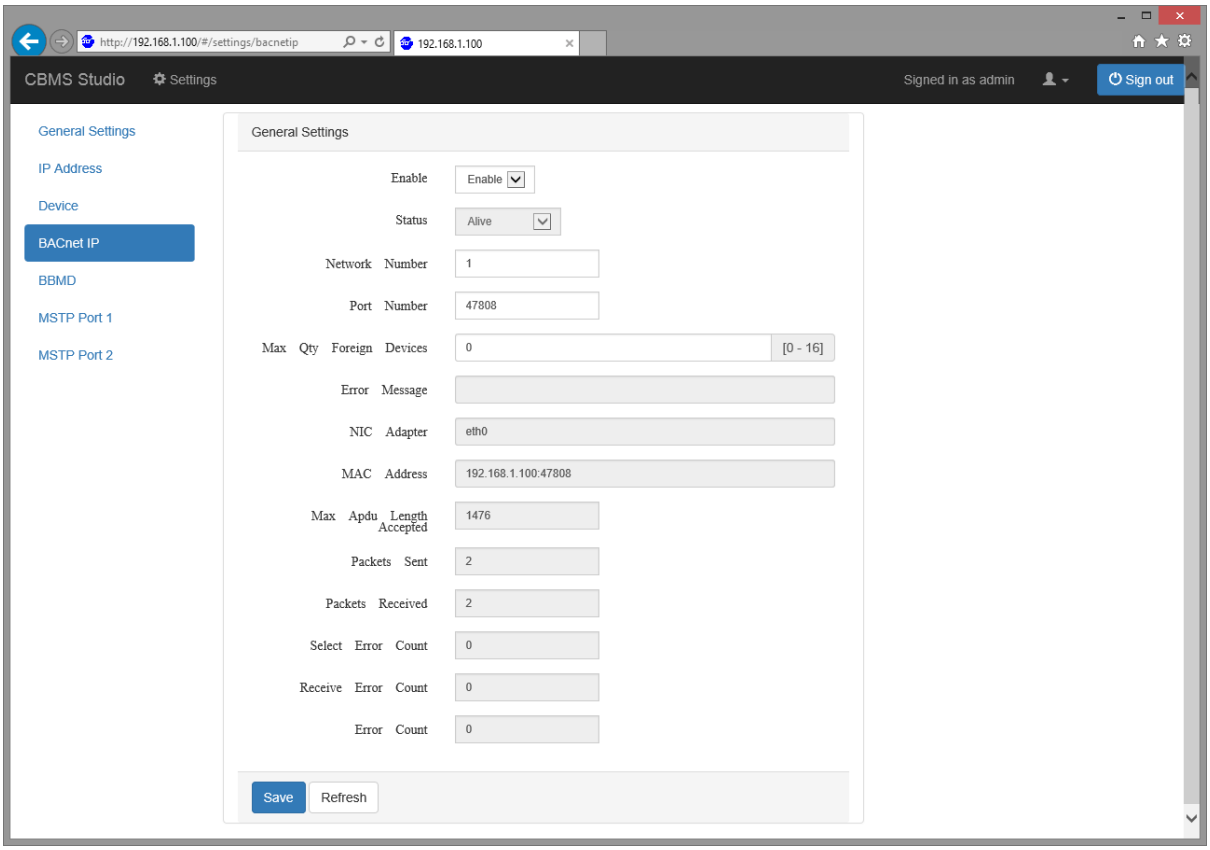
- Device ID. This is the BACnet device ID corresponding to the AAC-1000, it must be changed to a unique number on the BACnet network. The default value is 9999.
- Object Name. This property, of type CharacterString, shall represent a name for the object that is unique internetwork-wide. The minimum length of the string shall be one character. The set of characters used in the Object_Name shall be restricted to printable characters.
- Description. This property, of type CharacterString, is a string of printable characters that may be used to describe the application being carried out by the BACnet Device or other locally desired descriptive information.
- Location. This property, of type CharacterString, indicates the physical location of the BACnet Device.
- Application Software Version. This property, of type CharacterString, identifies the version of application software installed in the machine. The content of this string is a local matter, but it could be a date-and-time stamp, a programmer's name, a host file version number
- APDU Timeout. This property, of type Unsigned, shall indicate the amount of time in milliseconds between retransmissions of an APDU requiring acknowledgment for which no acknowledgment has been received. A suggested value for this property is 10,000 milliseconds for devices that permit modification of this parameter. Otherwise, the default value shall be 60,000 milliseconds. This value shall be non-zero if the Device object property called Number_Of_APDU_Retries is non-zero. In order to achieve reliable communication, it

is recommended that the values of the APDU_Timeout properties of the Device objects of all intercommunicating devices should contain the same value.

- APDU Segment Timeout. This property, of type Unsigned, shall indicate the amount of time in milliseconds between retransmission of an APDU segment. A suggested value for this property is 5000 milliseconds. This value shall be non-zero if the Device object property called Number_Of_APDU_Retries is non-zero. If segmentation of any kind is supported, then the APDU_Segment_Timeout property shall be present. In order to achieve reliable communication, it is recommended that the values of the APDU_Segment_Timeout properties of the Device objects of all intercommunicating devices should contain the same value.
- Number of APDU Retries. This property, of type Unsigned, shall indicate the maximum number of times that an APDU shall be retransmitted. A suggested value for this property is. If this device does not perform retries, then this property shall be set to zero. If the value of this property is greater than zero, a non-zero value shall be placed in the Device object APDU_Timeout property.
- Max Segments Accepted. This property, of type Unsigned, shall indicate the maximum number of segments of an APDU that this device will accept.

BACnet IP

From the BACnet IP page, the settings of the BACnet IP driver can be changed.



- Enable. This should be left as enabled and it should only be deactivated if the BACnet IP to MSTP routing is not required.
- Status. This is a read only value that displays the status of the port. If it is working correctly then it will display the text “Alive”.
- BACnet IP network number (1-65535). This value represents the BACnet IP network number for all devices connected to the IP network. All devices on the IP network should use the same network number. This setting defaults to 1 and can be left unchanged on most systems.
- BACnet IP Port number. The default setting is 47808 (0xBAC0) and can be left unchanged on most systems.Status
- Max Qty Foreign Devices. If the router is operating as a BBMD, then this value is used to specify the maximum number of foreign device connections that the AAC-1000 will accept.
- Error message. The error message for the BACnet IP port if there is an error condition.
- NIC Adapter. The NIC adapter used by the BACnet IP port.
- MAC Address. The BACnet MAC Address associated with this port.
- MAX Apdu Length Accepted. A read only value indicating the maximum APDU length accepted by this port.
- Packets Sent. The number of IP packets sent.
- Packets Received. The number of IP packets received.
- Select Error Count. The number of select errors for this port.
- Receive Error Count. The number of receive errors for this port.
- Error Count. The total number of errors for this port.

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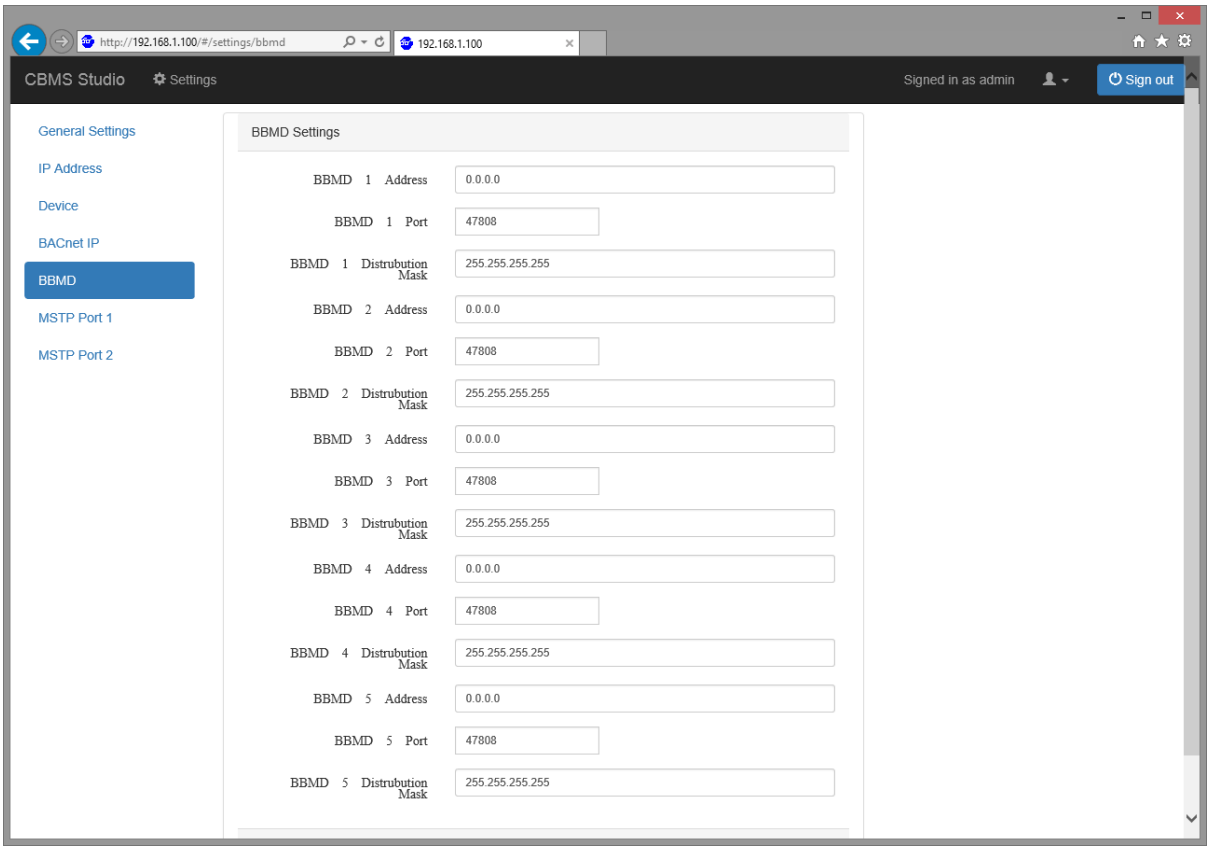
BBMD

The AAC-1000 can operate as a BBMD, to allow it to connect 2 different IP subnets together. When there are 2 subnets, then 1 AAC-1000 on each subnet should be configured as a BBMD and both BBMD's should have 2 entries containing for the IP address of each BBMD.



A maximum of 5 entries can be added to the Broadcast Distribution Table (BDT) of the AAC-1000, the settings for each entry are :-

- BBMD Address. This is the IP address of the BBMD which will receive broadcast messages.
- BBMD Port. The port number of the BBMD.
- BBMD Distribution mask. Normally set to 255.255.255.255, but it can be used to filter broadcast messages to the BBMD.

Note : Each BBMD should contain the same number of entries in it's Broadcast Distribution Table.

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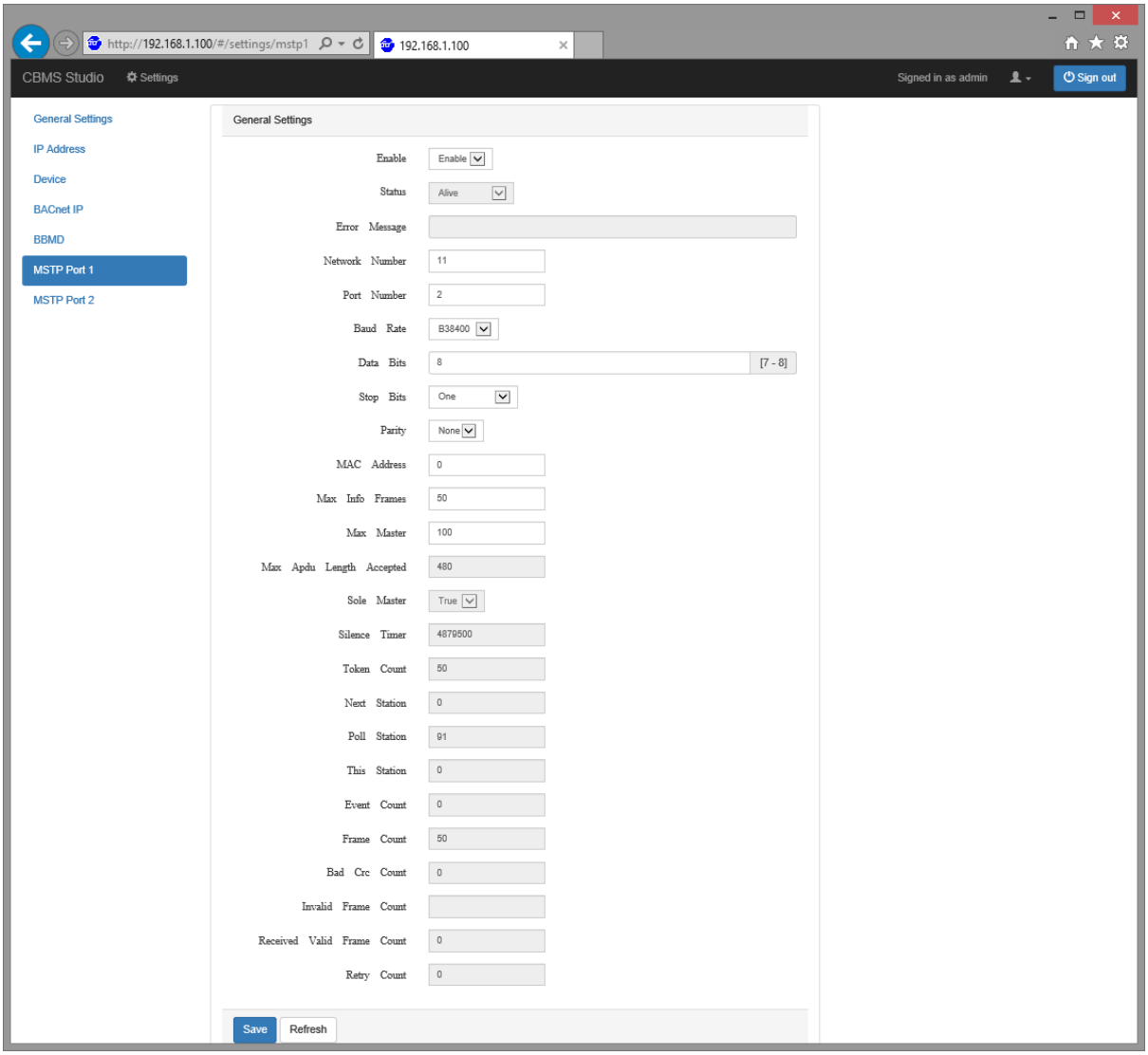
MSTP Port

There are 2 MSTP ports available on the AAC-1000 and there is a separate web configuration screen for each port as shown below.



- Enable. This should be left as enabled and it should be deactivated if the BACnet IP to MSTP routing is not required.
- Status. This is a read only value that displays the status of the port. If it is working correctly then it will display the text “Alive”.
- Error Message. This is normally empty, but if there is a n error then it will display a message.
- MSTP network number (1-65535). This value represents the BACnet MSTP network number for all devices connected to this MSTP port. This setting defaults to 11 and each MSTP port requires a unique network number. If there are multiple AAC-1000 devices used, then the network number on each MSTP port will need to be changed with a unique number.

- Port Number. This should not be changed, it represents the internal com port number used byt the AAC-1000 and will be either 2 or 4.
- Baud Rate. The AAC-1000 baud rate does not auto select and the value used should correspond to the value required by the MSTP devices.
- Data Bits. This value should always be set to 8 bits.
- Stop Bits. This value should always be set to 1.
- Parity. This value should always be set to none.
- MAC address. Each MSTP device requires a unique MAC address in the range 0-127. It is common for the MSTP router to have a MAC address of zero, so this value can be left unchanged for most systems.
- Max Info Frames. The default is 50 and it represents the value of the Max_Info_Frames property of the node's Device object. The value of Max_Info_Frames specifies the maximum number of information frames the node may send before it must pass the token. Max_Info_Frames may have different values on different nodes. This may be used to allocate more or less of the available link bandwidth to particular nodes. If Max_Info_Frames is not writable in a node, its value shall be 1.
- Max Master. The default is 100 and it represents the value of the Max_Master property of the node's Device object. The value of Max_Master specifies the highest allowable address for master nodes. The value of Max_Master shall be less than or equal to 127. If Max_Master is not writable in a node, its value shall be 127.
- MAX Apdu Length Accepted. A read only value indicating the maximum APDU length accepted by this port.
- Sole Master. MAX Apdu Length Accepted. A read only value indicating the maximum APDU length accepted by this port. If this value is true, then there are no other MSTP master devices connected to this port.
- Silence Timer. A timer with nominal 5 millisecond resolution used to measure and generate silence on the medium between octets. It is incremented by a timer process and is cleared by the Receive State Machine when activity is detected and by the SendFrame procedure as each octet is transmitted. Since the timer resolution is limited and the timer is not necessarily synchronized to other machine events, a timer value of N will actually denote intervals between N-1 and N. When this value continues to rise then it is an indication that there is a communication failure or no devices connected.
- Token count. The number of tokens received by this node. When this counter reaches the value Npoll, the node polls the address range between TS and NS for additional master nodes. TokenCount is set to one at the end of the polling process.
- Next Station. Is the MAC address of the node to which This Station passes the token. If the Next Station is unknown, NS shall be equal to TS.
- Poll Station. Is the MAC address of the node to which This Station last sent a Poll For Master. This is used during token maintenance.

- This Station. Is the the MAC address of this node. TS is generally read from a hardware DIP switch, or from nonvolatile memory. Valid values for TS are 0 to 254. The value 255 is used to denote broadcast when used as a destination address but is not allowed as a value for TS.
- Event Count. Used to count the number of received octets or errors. This is used in the detection of link activity
- Frame Count. The number of frames sent by this node during a single token hold. When this counter reaches the value Nmax_info_frames, the node must pass the token.
- Bad Crc Count. Number of CRC errors.
- Invalid Frame Count. Number of invalid frames.
- Received Valid Frame Count. Number of valid frames received.
- Retry Count. A counter of transmission retries used for Token and Poll For Master transmission.

CBMS Engineering Tool

Connect to the device

Using the Engineering Tool of your choice, connect to the device using a Sedona connection with the username and password set on the device. After the connection has been made, select the App node.

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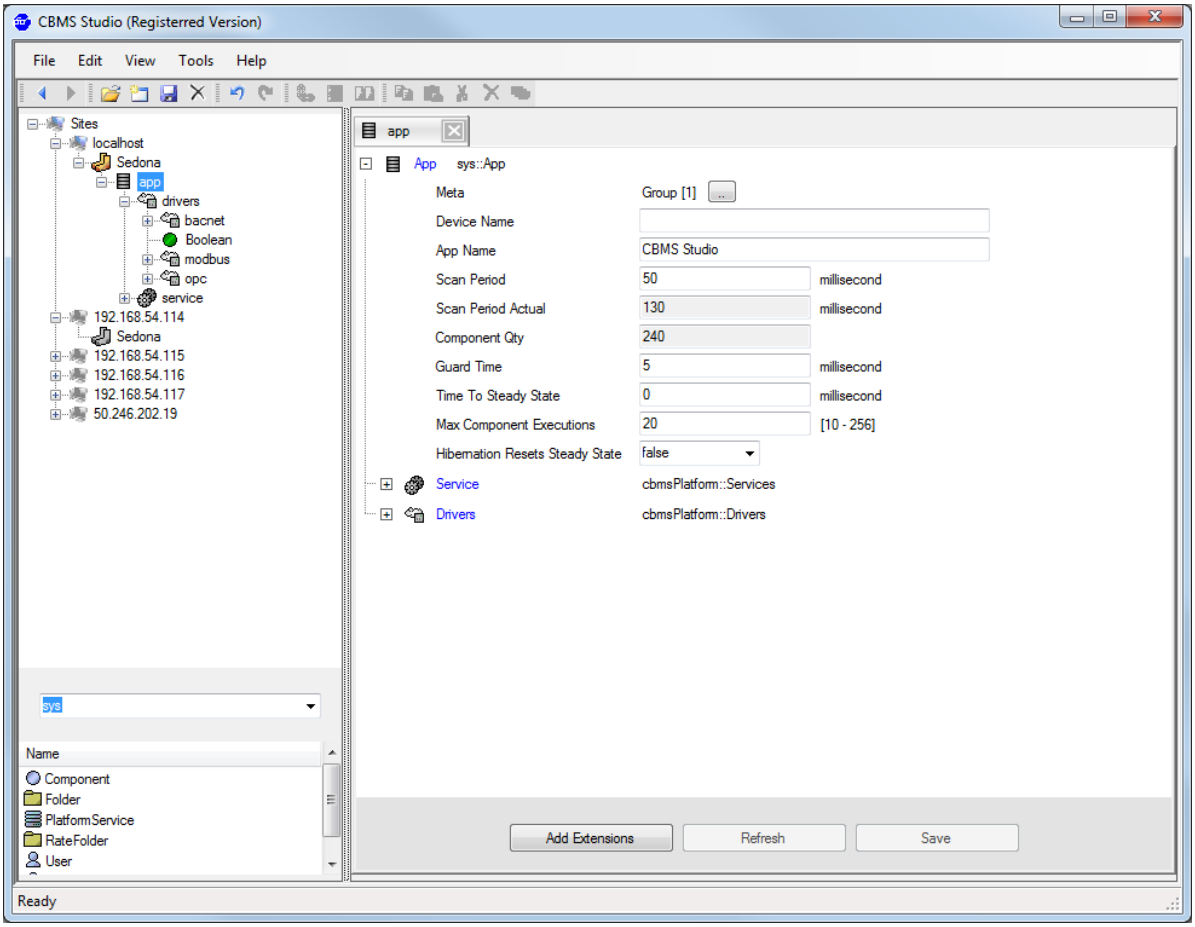

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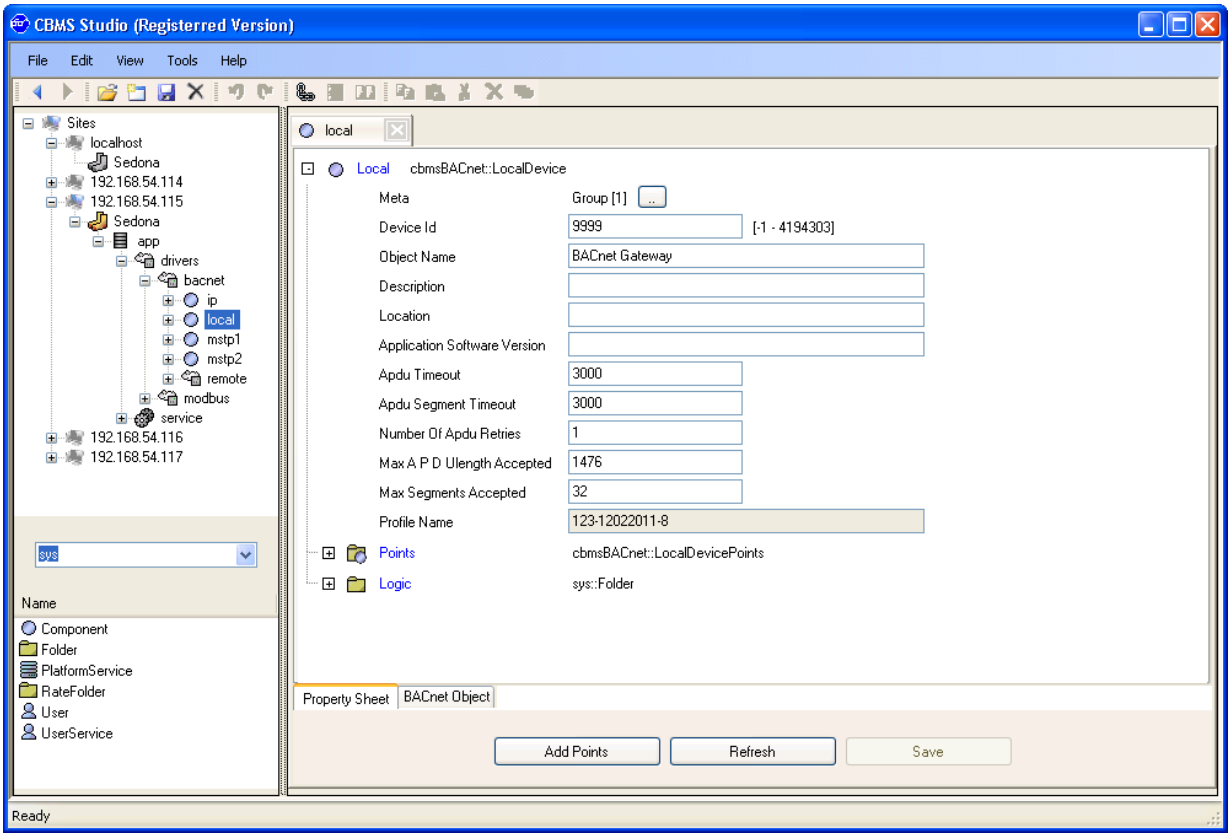
Configure BACnet Device Id

Once connected, navigate to the component labelled local under the path app/drivers/bacnet. This will display the cbmsBACnet::LocalDevice component and within the form there is a property called device Id. By default this will be set to 9999 and it should be changed on site to a unique number across all networks. For example, if 10 BACnet routers are installed, then each router must be given a different device Id.

To change the value of the device ID, simple type a new value into the text box located next to the label for the device Id and then select the save button at the lower right hand side of the engineering tool. This will write the value to the application.

After updating any value it is held in memory by the device. To make it persistent so that it is loaded again after a restart, the application itself requires saving. To do this press the “save” button in the toolbar.



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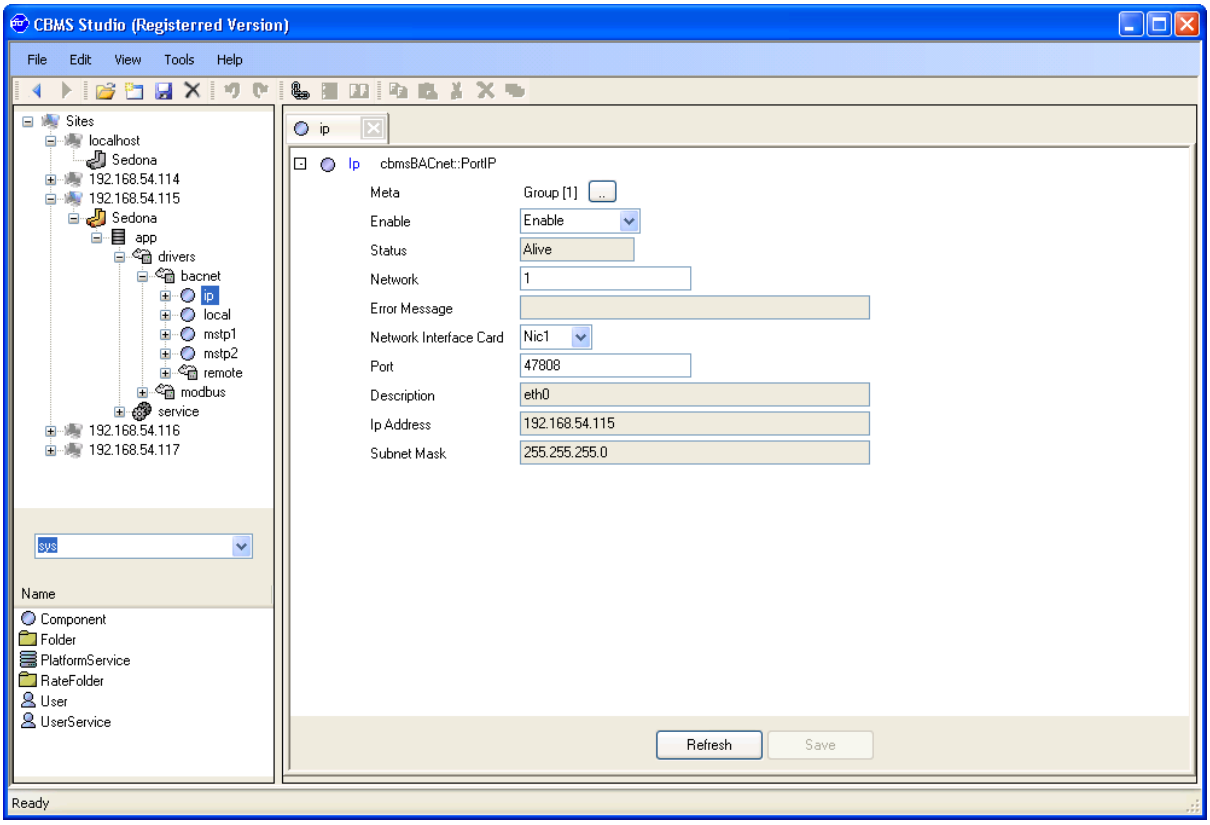
Configure BACnet IP Network Number

Navigate to the component labelled ip under the path app/drivers/bacnet. This will display the cbmsBACnet::PortIp component and within the form there is a property called network. By default this will be set to 1. This represents the network number for the Ethernet network and all devices physically connected to the Ethernet network should have their network number set to the same value. For example, if there are 10 routers connected to the Ethernet network, then each router should have the same IP network number assigned, eg 1.



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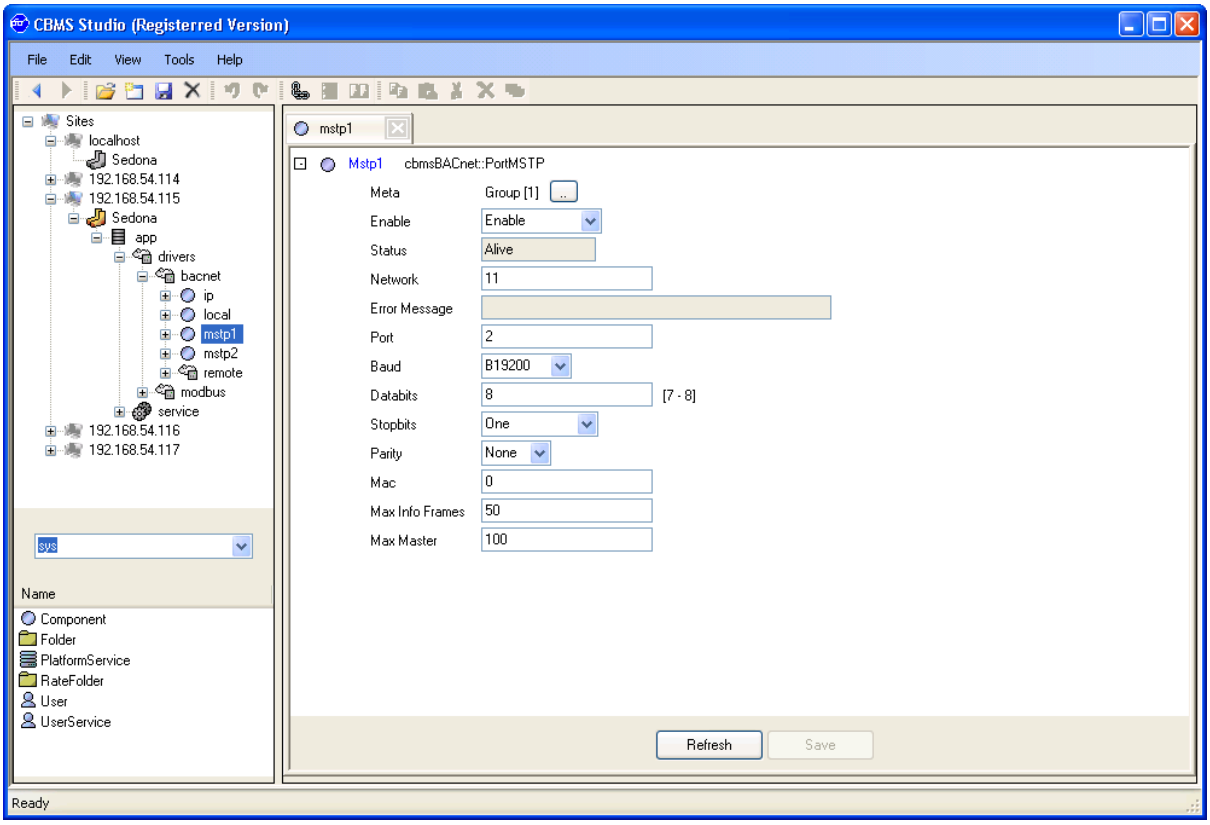
Configure BACnet MSTP Network Number

There are 2 MSTP ports configured by default on the BACnet router called mstp1 and mstp2.

Navigate to the component labelled ip under the path app/drivers/mstp1. This will display the cbmsBACnet::PortMSTP component and within the form there is a property called network. By default this will be set to 11 and mstp2 will be set to 21. This represents the network number for all of the devices physically connected to the RS485 port.

Network numbers need to be unique, so if 2 routers are installed the router 1 and router 2 cannot use network 21 for the MSTP network.

If the MSTP port is not in use, the Enable property should be set to disabled. This will turn off routing for the RS485 port.



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Settings

Local Device

apduSegmentTimeout

```
public property int apduSegmentTimeout [config]
```

The APDU_Segment_Timeout property, of type Unsigned, shall indicate the amount of time in milliseconds between retransmission of an APDU segment. A suggested value for this property is 5000 milliseconds. This value shall be non-zero if the Device object property called Number_Of_APDU_Retries is non-zero. If segmentation of any kind is supported, then the APDU_Segment_Timeout property shall be present. In order to achieve reliable communication, it is recommended that the values of the APDU_Segment_Timeout properties of the Device objects of all intercommunicating devices should contain the same value.

apduTimeout

```
public property int apduTimeout [config]
```

The APDU_Timeout property, of type Unsigned, shall indicate the amount of time in milliseconds between retransmissions of an APDU requiring acknowledgment for which no acknowledgment has been received. A suggested value for this property is 10,000 milliseconds for devices that permit modification of this parameter. Otherwise, the default value shall be 60,000 milliseconds. This value shall be non-zero if the Device object property called Number_Of_APDU_Retries is non-zero. In order to achieve reliable communication, it is recommended that the values of the APDU_Timeout properties of the Device objects of all intercommunicating devices should contain the same value.

applicationSoftwareVersion

```
public inline property Buf applicationSoftwareVersion [config,
max=64]
```

This property, of type CharacterString, identifies the version of application software installed in the machine. The content of this string is a local matter, but it could be a date-and-time stamp, a programmer's name, a host file version number, etc. @asStr

description

```
public inline property Buf description [asStr, config, max=64]
```

This property, of type CharacterString, is a string of printable characters that may be used to describe the application being carried out by the BACnet Device or other locally desired descriptive information.

deviceId

```
public property int deviceId [min=-1, config, max=4194303]
```

location

```
public inline property Buf location [asStr, config, max=64]
```

This property, of type CharacterString, indicates the physical location of the BACnet Device.

maxAPDUlengthAccepted

```
public property int maxAPDUlengthAccepted [config]
```

This property, of type Unsigned, is the maximum number of octets that may be contained in a single, indivisible application layer protocol data unit. The value of this property shall be greater than or equal to 50. The value of this property is also constrained by the underlying data link technology. @config property int maxAPDUlengthAccepted = 1476

maxSegmentsAccepted

```
public property int maxSegmentsAccepted [config]
```

The Max_Segments_Accepted property, of type Unsigned, shall indicate the maximum number of segments of an APDU that this device will accept.

numberOfApduRetries

```
public property int numberOfApduRetries [config]
```

The Number_Of_APDU_Retries property, of type Unsigned, shall indicate the maximum number of times that an APDU shall be retransmitted. A suggested value for this property is. If this device does not perform retries, then this property shall be set to zero. If the value of this property is greater than zero, a non-zero value shall be placed in the Device object APDU_Timeout property

objectContainer

```
public Obj objectContainer
```

objectName

```
public inline property Buf objectName [asStr, config, max=64]
```

This property, of type CharacterString, shall represent a name for the object that is unique internetwork-wide. The minimum length of the string shall be one character. The set of characters used in the Object_Name shall be restricted to printable characters.

profileName

```
public inline property Buf profileName [asStr, config, max=32,
readonly]
```

This optional property, of type CharacterString, is the name of an object profile to which this object conforms. To ensure uniqueness, a profile name must begin with a vendor identifier code (see Clause 23) in base-10 integer format, followed by a dash. All subsequent characters are administered by the organization registered with that vendor identifier code. The vendor identifier code that prefixes the profile name shall indicate the organization that publishes and maintains the profile document named by the remainder of the profile name. This vendor identifier need not have any relationship to the vendor identifier of the device within which the object resides. A profile defines a set of additional properties, behavior, and/or requirements for this object beyond those specified here.

BACnet IP Port

description

```
public inline property Buf description [asStr, max=256, readonly]
```

The IP Address of the NIC adapter

idx

```
public inline property Buf idx [asStr, config, max=32, hidden]
```

The Subnet Mask of the NIC adapter

ipAddress

```
public inline property Buf ipAddress [asStr, max=32, readonly]
```

The IP Address of the NIC adapter

networkInterfaceCard

```
public property int networkInterfaceCard [config, range="Nic1, Nic2,
Nic3, Nic4, Nic5, Nic6, Nic7, Nic8, Nic9, Nic10"]
```

port

```
public property int port [config]
```

The IP Port Number

subnetMask

```
public inline property Buf subnetMask [asStr, max=32, readonly]
```

The Subnet Mask of the NIC adapter

BACnet MSTP Port

baud

```
public property int baud [config, range="B110, B300, B600, B1200,
B2400, B4800, B9600, B14400, B19200, B38400, B56000, B57600, B115200,
B128000, B256000"]
```

Integer value of baud rate; set of permissible values is platform-dependent. Defaults to 9600

databits

```
public property int databits [min=7, config, fieldWidth=2, max=8]
```

The com port dat bits

mac

```
public property int mac [config]
```

The MAC Address of This Station

maxInfoFrames

```
public property int maxInfoFrames [config]
```

The MAX Info Frames. Default 50 This parameter represents the value of the Max_Info_Frames property of the node's Device object. The value of Max_Info_Frames specifies the maximum number of information frames the node may send before it must pass the token. Max_Info_Frames may have different values on different nodes. This may be used to allocate more or less of the available link

bandwidth to particular nodes. If Max_Info_Frames is not writable in a node, its value shall be 1.

maxMaster

```
public property int maxMaster [config]
```

Max Master, default = 100. This parameter represents the value of the Max_Master property of the node's Device object. The value of Max_Master specifies the highest allowable address for master nodes. The value of Max_Master shall be less than or equal to 127. If Max_Master is not writable in a node, its value shall be 127.

parity

```
public property int parity [config, range="None, Even, Odd"]
```

The com port parity, 'None', 'Even' or 'Odd'. Defaults to none.

port

```
public property int port [config, fieldWidth=4]
```

The Com Port number, Defaults to 1

stopbits

```
public property int stopbits [config, range="One, OneAndAHalf, Two"]
```

The com port stop bits. Defaults to 1